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Outside Investor Access to Top Management: Market Monitoring versus Stock Price Manipulation

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Abstract

This paper studies the role of voluntary disclosure in crowding out independent research about firm value. In the model, when inside firm owners make it easier for outside investors to obtain inexpensive biased information from the manager, investors rely less on costly unbiased research. As a result, managers are tempted to manipulate the firm stock price more, but investors are better informed because they anticipate manager manipulation. An increase in stock-price informativeness, therefore, has to be traded off against an increase in resources wasted on manipulation. I find that, surprisingly, firm owners grant investors more access to managers that manipulate more strongly. An implication is that the firm cost of capital is negatively related to manager manipulation.

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1 Introduction

Top management often provides additional voluntary disclosure to market participants—for example, through conference calls or presentations (Francis, Hanna, and Philbrick, 1997; Frankel, Johnson, and Skinner, 1999; Bushee, Jung, and Miller, 2011; Green, Jame, Markov, and Subasi, 2014).[1] On the one hand, additional disclosure may make a firm's stock price more informative, thereby strengthening manager incentives to increase firm value (Fishman and Hagerty, 1989; Holmstrom and Tirole, 1993). On the other hand, managers might use the opportunity to influence the value of their pay related to the firm's stock price in a way that reduces the firm's value (Hollander, Pronk, and Roelofsen, 2010; Mayew and Venkatachalam, 2012). I study this trade-off and identify the firm and manager characteristics that determine whether letting managers talk to investors increases a firm's value.

The paper uses a model that builds on the one in Schroth (2018), in which market participants trade firm stocks and obtain information about the future value of firms from firm managers. Managers have an incentive to bias such information because firm owners award them some short-term equity incentives given managerial risk aversion. This paper adds that market participants can become privately informed about the future value of the firm by obtaining information not only from the manager but also from their own independent research. I assume that firm owners can determine the cost that market participants expend on each piece of information from

[1] While Regulation Fair Disclosure requires that managers disclose only non-material information during private events, it permits that attending investors combine such non-material information, and possibly public information, into a piece of information that ends up being material. Almazan, Banerji, and De Motta (2008) explicitly model how managerial "cheap talk" can guide market participants to create new and useful information about the firm. Anantharaman and Zhang (2011), Balakrishnan, Billings, Kelly, and Ljungqvist (2014) and Guay, Samuels, and Taylor (2016) find that management sometimes increases voluntary disclosure to offset exogenous decreases in market-participant information about the firm.

the manager. The motivation for this assumption is that firms differ in practice in how frequently their top management gives, for example, conference calls or presentations.[2] In the model, firm owners trade off increasing stock-price informativeness and decreasing resources wasted on manager manipulation. As a result, firm owners will link equity incentives and investor access to management. To the extent that man-agers differ in their intent to manipulate the information they supply to investors, an optimal compensation scheme implies cross-sectional relationships between investor access, cost of capital, equity pay, and manipulation.

There are four main results. The first is that an optimal compensation scheme implies a positive relationship between short-term focus of equity incentives and investor access to managers. A firm owner that can observe a manager's intent to manipulate will give fewer short-term equity incentives to managers with stronger intent to manipulate and will also limit investor access to those managers. However, a firm owner that cannot observe the manager's intent to manipulate would do the opposite—they would give more short-term equity incentives to managers with stronger intent and increase investor access to those managers. The reason for this reversal is that firm owners must provide incentives to managers to reveal their manipulation intent and they also have an interest in reducing associated manager information rents. In either case, managers with stronger short-term incentives talk more to market participants.

The second result is that when firm owners cannot observe the intent of managers to manipulate then manipulation and investor access to managers are positively re-

[2]When managers supply more information, then it becomes cheaper for market participants to obtain private information based on manager non-material information in the model. Intuitively, market participants must spend fewer resources to obtain a given piece of information when managers give them more guidance about "where to look." I assume such cheap talk is costless for the manager and thus set the cost to the firm of supplying information through, for example, conference calls or presentations to zero in my model.

lated (and they are negatively related otherwise). When managers earn information rents from privately observing their manipulation intent, then managers with stronger intent receive stronger short-term incentives and also talk more to market participants. As a result, managers that manipulate more will talk more to market participants.

The third result identifies characteristics of firms and managers that motivate limits on manager communication with market participants. A low manager risk aversion implies a lower need for balanced equity incentives. Firm owners can limit manager communication in this case and, as the short-term stock price becomes less sensitive to managerial effort, reduce short-term pay. Similarly, when market liquidity is high in the sense of many noise traders buying or selling the firm stock in the short term, or when earnings quality is high in the sense of speculator signals being highly correlated with firm future value, then market participants already conduct more own research about firm future prospects and firm owners see less use in letting them talk to managers.[3]

The fourth result considers the case where firm owners can change the amount of shares held by outside investors (i.e., the liquidity of firm stocks) when contracting with managers. Access to managers is still positively related to manipulation in this case. In addition, firm owners lower the liquidity of the stock when increasing access such that access to managers reduces the cost of capital (i.e., they reduce the discount given to unsophisticated liquidity traders). Consequently, the cost of capital is *negatively* related to manager manipulation.

[3]The recent ongoing decline in earnings quality (Lev and Zarowin, 1999) has been linked to the rise of intangible assets (Srivastava, 2014). The model is thus consistent with higher intangible intensity being a driver of the recent increase in the incidence of voluntary disclosure.

1.1 Related literature

Almazan, Banerji, and De Motta (2008) also study the link between managerial compensation and firm disclosure policy. Voluntary disclosure can be verified by market participants in their model, and the analysis focuses on how firm owners can incentivize managers to provide voluntary disclosure. Specifically, they find that more voluntary disclosure on average is complementary to managers' short-term equity pay. The reason is that managers can use voluntary disclosure to draw attention to the good work they have been doing thereby increasing the sensitivity of the short-term stock price to managerial performance.[4] In contrast, in the model in this paper, firm owners face the problem that voluntary disclosure remains biased. As a result, managers are always willing to provide it, and the analysis focuses on whether firm owners should grant market participants access to managers' voluntary disclosure.

The model in Schroth (2018) offers an explanation for the relationships between equity incentive pay and earnings manipulation (discretionary accruals) documented in Bergstresser and Philippon (2006) and Gopalan et al. (2014). This paper, in contrast, focuses on managerial guidance that allows investors to better forecast future earnings. The implicit assumption in this paper is that earnings guidance, and especially more disaggregated or long-term projections,[5] has a greater influence on investor expectation about a firm's future performance than current earnings manipulation. Therefore, the former is seen as crowding out independent investor research but the latter is not.

[4]Enache, Li, and Riedl (2018) study voluntary disclosure in the US biotech industry and find that managers have incentive to provide product-level voluntary disclosure, especially if it involves good news.

[5]Hirst, Koonce, and Venkataraman (2007) find that managerial guidance is more useful to market participants if it is more disaggregated rather than just focusing on earnings. Jamie Dimon and Warren E. Buffett recently called for more long-term projections provided to investors to replace short-term earnings guidance (*Wall Street Journal*, 2018).

In Lin, Liu, and Sun (2019), the manager obtains information from market participants rather than the other way around, as in Almazan, Banerji, and De Motta (2008). An exogenous increase in informed trading activity lowers the need for equity pay in Lin, Liu, and Sun (2019) because both an increase in stock-price informativeness and an increase in equity pay act as attenuating managerial objectives in empire building. In Almazan, Banerji, and De Motta (2008), and in this paper, market interest in the firm stock and equity pay are complements—while they are substitutes in Lin, Liu, and Sun (2019)—because higher market interest in the firm implies that equity pay becomes more effective in generating market monitoring. Jayaraman and Milbourn (2011) find that across large US firms exogenous shocks to liquidity and subsequent changes in equity pay are positively related, suggesting that, on net, complementarity dominates substitutability in their data set.

A large empirical literature studies the link between accounting choices and cost of capital. The analysis in this paper shows the importance of considering that accounting choices might be in part driven by concerns about manager manipulation of a firm's stock price. For example, Francis, Nanda, and Olsson (2008) find that voluntary disclosure can reduce the cost of capital, but that the effect disappears when controlling for a measure of manipulation. Strobl (2013) finds conditions under which costly earnings manipulation is pro-cyclical; this lowers the variance of cash flows, which in turn reduces the cost of capital. I abstract from asset-pricing considerations, so that in my model, the cost of capital is driven by market microstructure considerations, as in Easley and O'hara (2004).

The prediction in this paper that access to managers and cost of capital are negatively related is in line with Bertomeu, Beyer, and Dye (2011), where voluntary disclosure reduces the cost of capital. However, my analysis gives an example for when the cost of capital is not necessarily a measure of the strength of accounting frictions. Even though voluntary disclosure increases, a decrease in cost of capital may not be driven by a reduction of such frictions—on the contrary, it may reflect that the manager has a higher propensity to manipulate and, indeed, manipulates more.

In the model in this paper, constraining management disclosure, by limiting investor access to management, reduces managerial manipulation, but this has the side effect of reducing the effectiveness of market monitoring. Real manipulation, such as over- or under-investment in research and development, can be another side effect of constraining manager disclosure discretion. Specifically, real manipulation is one way in which managers affect financial disclosure in practice (Graham, Harvey, and Rajgopal, 2005); tighter disclosure regulation that limits earnings misreporting may therefore push managers to rely more on real manipulation. Indeed, Cohen, Dey, and Lys (2008) find evidence of increased real manipulation after the Sarbanes-Oxley Act of 2002 reduced the scope for accrual-based manipulation.[6] In a quantitative analysis, Terry, Whited, and Zakolyukina (2018) estimate that overly tight disclosure regulation can reduce firm value significantly through distorted real investment.[7] Tighter disclosure regulation may also lower long-term investment in intangibles: not by creating an incentive for real manipulation but by shifting the focus of performance pay onto short-term activities that are more reliably measured (Edmans, Heinle, and Huang, 2016; Bénabou and Tirole, 2016). Similarly, Hermalin and Weisbach (2012) show that

[6]Goldman and Slezak (2006) show that a regulatory reform that increases penalties and detection probabilities related to manipulation may lead to firms offering higher powered incentive contracts, which may end up inducing manipulation that is even higher than before the reform.

[7]Work by Lara, Osma, and Penalva (2016) suggests that firms where the manager has a reputation for conservatism—i.e., the manager is expected to recognize negative events in a timely manner—may be less affected by such tightening of disclosure regulation.

tighter disclosure that increases market monitoring may shift managerial activity in a less efficient direction or cause disutility to managers who in turn demand higher pay.

While the analysis in this paper focuses on access to management as a way to increase stock price informativeness, Ferreira, Ferreira, and Raposo (2011) find that firms also adjust the structure of their boards in response to insufficient stock price informativeness.

2 Model

Agents

Consider the case of a publicly traded firm that is being run by a manager who does not initially own any stock. Stock is held by inside owners, liquidity traders, a speculator and a market maker. It is assumed that while inside owners and market participants are risk neutral, the manager is risk averse with constant absolute risk aversion $r > 0$. The manager can provide effort e and manipulation m. However, it is assumed that firm owners do not observe manager actions e and m. Let w denote manager compensation, then the manager's net certainty equivalent (assume a zero outside option) is

$$u(w, e, m) = E(w) - \frac{r}{2}Var(w) - q(e, m), \tag{2.1}$$

where $q(e, m) = \frac{1}{2}e^2 + \frac{1}{2\gamma}m^2$ is the cost of activities e and m, and $E(w)$ and $Var(w)$ denote expectation and variance of manager compensation, respectively. The parameter $\gamma > 0$ denotes the manager's manipulation propensity. In the model, managers differ in their manipulation propensity, and there is empirical evidence suggesting that they also do so in practice (Francis, Huang, Rajgopal, and Zang, 2008; Demerjian, Lev, Lewis, and McVay, 2012; Dikolli, Keusch, Mayew, and Steffen, 2020).

Timing and technology

The model has one period, which consists of three parts. In the first part, the firm is established and inside owners contract with the manager. In the second part, the speculator observes his or her private signal s and trades the firm's stock, taking liquidity trader demand as given. Inside owners are not trading stock at this interim stage.[8] In the third part, firm value is realized, and the manager is compensated. Firm liquidation value is determined by manager effort and two independent shocks, θ and ϵ,

$$\pi = e + \theta + \epsilon, \tag{2.2}$$

with $\theta \sim N(0, \sigma_\theta^2)$, $\epsilon \sim N(0, \sigma_\epsilon^2)$, and $\sigma_\theta^2, \sigma_\epsilon^2 > 0$. The role of the second noise term ϵ is to create a motive for making manager pay conditional on the interim stock price.

Information

At the beginning of the period, managers privately observe their respective manipulation propensity γ. The inside owner knows that γ can take one of two values, $\gamma_L > 0$ and $\gamma_H > \gamma_L$, with $Prob(\gamma = \gamma_L) = \rho \in (0, 1/2)$. For example, γ is high if the manager is good at conveying a biased interpretation of news about the firm without becoming legally liable in any way. In that sense, the set $\{\gamma_L, \gamma_H\}$ and the distribution implied by ρ can be thought of as given by the regulatory and technological environment, affecting all firms equally.

In the second part of the period, the speculator obtains a signal s about future firm

[8]One could think about inside owners colluding with the manager, and trading against liquidity traders as well as speculators. Assuming that inside traders do not trade at the interim stage allows us to restrict attention to the case where inside owners focus on the firm's long-term value rather than on the interim stock price.

value. It is given by

$$s = e + \bar{m} + \theta + \eta, \tag{2.3}$$

where $\eta \sim N(0, \sigma_\eta^2)$, $\sigma_\eta^2 \geq 0$, is noise and $\bar{m}$ is an additional bias that the manager effectively attaches. The signal summarizes information that becomes available to the speculator through the speculator both conducting own independent research and following firm voluntary disclosure. Each piece of independent research is the realization of a random variable $s_{1,i} = e + \theta + \eta_i$, with $i = 1, 2, \ldots, n_1$, and each piece of information based on firm voluntary disclosure is given by $s_{2,i} = e + m + \theta + \eta_i$, with $i = 1, 2, \ldots, n_2$. The random variables $\eta_i \sim N(0, 1)$ are independently and identically distributed. Note that for given speculator choice of n_1 and n_2, and manager manipulation m, the effective bias is $\bar{m} = \frac{n_2}{n_1+n_2} m$ and the precision parameter σ_η^2 is $\frac{1}{n_1+n_2}$. The choice of n_1 and n_2 is observed only by the speculator.

To simplify the analysis, it is assumed that n_1 and n_2 are continuous choice variables for the speculator. The cost of information to the speculator is $\frac{1}{2} n_1^2 + c n_2$ where $c \in [0, \infty)$ is chosen by the firm owner.[9] Therefore, managers can manipulate voluntary disclosure—for example, by directly setting the tone of voluntary disclosure or, indirectly, by influencing the CFO—but the firm owner chooses how much voluntary disclosure is offered.

Compensation contract

Compensation can depend on the interim stock price, realized firm liquidation value and announced manager manipulation propensity. It is assumed that inside owners

[9] Because c is observable, and the considered contracts below are optimal, it is effectively the firm owner who chooses c. A lower value of c means that voluntary disclosure is more readily available to market participants. In practice, firms differ in the amount of voluntary disclosure—for example, in the form of investor conference presentations or long-term forecasts—they provide.

restrict compensation schemes to be linear in interim stock price P and liquidation value π, but possibly non-linear in announced manipulation propensity. In particular, manager compensation is

$$w = a_1 \pi + a_2 P + a_3, \tag{2.4}$$

where a_1 denotes long-term equity incentives, a_2 denotes short-term equity incentives and a_3 denotes cash compensation. Holmstrom and Tirole (1993) and Peng and Röell (2014) also distinguish between short- and long-term equity pay. As in their models, firm owners in this model base compensation on both a short-term and a long-term signal of managerial effort to reduce costs associated with risk borne by the risk-averse manager.

It is assumed that firm inside owners offer a menu of contracts such that managers—by choosing particular contracts—reveal their actual manipulation propensities. In particular, a compensation contract is denoted by $(a_1(\hat{\gamma}), a_2(\hat{\gamma}), a_3(\hat{\gamma}))$, where $\hat{\gamma}$ denotes the manipulation propensity that the manager reveals. It is further assumed that the inside owner will communicate the details of the compensation contract to the speculator and the market maker (recall that the inside owner is not trading the stock at the interim stage). Market participants can therefore back out manager manipulation propensities.

It is worthwhile to briefly discuss the motivation behind these two assumptions. Suppose they do not hold; then market participants cannot differentiate between managers of different manipulation types and, as a result, discount signals too much when the manager has a low type and too little when the manager has a high type. Inside owners must therefore increase fixed pay for all managers to compensate the low manipulation types for diminished pay (because of temporary firm stock undervaluation) to ensure the participation of low types. But this higher fixed pay is also enjoyed by high manipulation types, who, in addition, benefit from temporary overvaluation of the firm's stock. However, when inside owners pay an information rent to high manipulation types—equivalent to a temporary overvaluation they could achieve by not revealing their high type—they achieve separation that protects low types from temporary undervaluation of the firm's stock and thus eliminates the need to raise fixed pay.[10]

3 Stock price

Let $\hat{e}$ and $\hat{m}$ be the expected equilibrium effort and manipulation levels, respectively, when the revealed manipulation propensity is $\hat{\gamma}$. Also, let the exogenous demand of liquidity traders be given by $y \sim N(0, \sigma_y^2)$, $\sigma_y^2 > 0$. The role of liquidity traders is to give the speculator the opportunity to partially hide its demand and reduce its price impact.[11] Suppose the speculator's demand when propensity $\hat{\gamma}$ is revealed is linear in its signal,

$$x(s) = \xi_1 + \xi_2 s. \tag{3.1}$$

Verification of this linear demand rule and computation of the equilibrium interim stock price are very similar to the analysis in Holmstrom and Tirole (1993) and yield the same speculator demand and equilibrium stock price.

[10] In an equilibrium of the model, separation implies that managers provide as much manipulation as is expected of them. This model feature is consistent with empirical findings that manipulation is statistically but not obviously economically significant (e.g., Aboody and Kasznik, 2000). However, manipulation has important indirect consequences in my model: it distorts the compensation contract, even though it is not able to directly affect the interim stock price in an equilibrium.

[11] Garriott and Riordan (2019) analyze data from the Toronto Stock Exchange and find that informed traders actively seek to trade in the presence of uninformed traders.

Proposition 1. *1. The speculator's trading rule is characterized by*

$$\xi_1 = -\left[\hat{e} + \frac{n_2}{n_1 + n_2}\hat{m}\right] \frac{\sigma_y}{(\sigma_\theta^2 + \sigma_\eta^2)^{1/2}}$$

$$\xi_2 = \frac{\sigma_y}{(\sigma_\theta^2 + \sigma_\eta^2)^{1/2}}.$$

2. The equilibrium price is given by

$$P = \hat{e} + \frac{\sigma_\theta^2(\theta + \eta)}{2(\sigma_\theta^2 + \sigma_\eta^2)} + \frac{\sigma_\theta^2}{2(\sigma_\theta^2 + \sigma_\eta^2)^{1/2}} \frac{y}{\sigma_y}.$$

Proof. See Appendix A.1. □

Note that the speculator's demand does not depend on the truthfully revealed manipulation propensity since

$$x(s) = \xi_1 + \xi_2 s = \frac{\sigma_y}{(\sigma_\theta^2 + \sigma_\eta^2)^{1/2}}(\theta + \eta) \text{ for all } \hat{e}, \hat{m}.$$

The reason is that the speculator and market maker are equally informed about the manager's manipulation propensity. This is the case since the compensation contract induces separation and is communicated to market participants. In equilibrium, managers will provide as much manipulation as expected by market participants. Note that there will be a strictly positive amount of manipulation in equilibrium, since managers cannot credibly commit not to use manipulation to distort the speculator's signal. This is similar to the kind of dilemma studied in Stein (1989).

To better understand the manager's dilemma and incentive problem, consider the following argument out of equilibrium. Let $e = e(\gamma, \hat{\gamma})$ and $m = m(\gamma, \hat{\gamma})$ be the actual manager choices when the true manipulation propensity is γ but $\hat{\gamma}$ is revealed. Let $\hat{e} = e(\hat{\gamma}, \hat{\gamma})$ and $\hat{m} = m(\hat{\gamma}, \hat{\gamma})$ be the manager choices when the true propensity is $\hat{\gamma}$. Then at the beginning of the period, the expected interim stock price from the viewpoint of the manager with true manipulation propensity γ and revealed propensity $\hat{\gamma}$ is

$$\hat{E}(P) = \hat{e} + \frac{\psi}{2}\left(e + \frac{n_2}{n_1 + n_2} m\right) - \frac{\psi}{2}\left(\hat{e} + \frac{n_2}{n_1 + n_2}\hat{m}\right), \tag{3.2}$$

where $\psi = \frac{\sigma_\theta^2}{\sigma_\theta^2 + \sigma_\eta^2}$ is the signal-to-noise ratio, and $\hat{E}$ denotes the expectation of the manager when market participants believe manipulation propensity is $\hat{\gamma}$ while actual manipulation propensity is γ. For given $\hat{e}$ and $\hat{m}$ the manager always has an incentive to provide not only effort e but also manipulation m to increase the interim stock price. While managers always have an incentive to ex post manipulate the speculator's signal, they also have an incentive to understate their manipulation propensity to achieve an overvaluation of the firm's stock at the interim stage via $m > \hat{m}$. The inside owner must thus offer a compensation contract that discourages mangers from increasing the value of short-term pay by understating their manipulation propensity and surprising market participants with higher-than-expected manipulation $m > \hat{m}$.

The waste of resources due to manipulation as well as the inside owner's concern with misrepresentation of manipulation propensities make compensation that is based on the interim (or short-term) stock price P expensive relative to compensation based on the realized liquidation value π. The following section shows how these additional costs of short-term incentives affect the optimal compensation scheme.

3.1 Strength of market monitoring

Speculators obtain information to influence the precision of the signal s they receive about future firm value. Their maximization problem takes the following form:

$$\max_{n_1,n_2\geq 0}\left\{\mathbb{E}_s\left[x(s)\left(\mathbb{E}(\pi|s)-\mathbb{E}(P|x(s))\right)\right]-\frac{1}{2}n_1^2-cn_2\right\}, \tag{3.3}$$

where $\mathbb{E}_s$ denotes expectation over s. The speculator anticipates to choose demand x optimally. Therefore, an envelope condition implies that any effect of the information choice on x can be ignored. The problem (3.3) can then be expressed as

$$\max_{n_1,n_2\geq 0}\left\{\mathbb{E}\left[(\theta+\eta)\hat{\xi}_2\left((\theta+\eta)\frac{\sigma_\theta^2}{\sigma_\theta^2+\sigma_\eta^2}-(\theta+\eta)\frac{\hat{\xi}_2^2\sigma_\theta^2}{\sigma_y^2+\hat{\xi}_2^2(\sigma_\theta^2+\hat{\sigma}_\eta^2)}\right)-\frac{1}{2}n_1^2-cn_2\right]\right\}$$

and further simplified as follows:

$$\max_{n_1,n_2\geq 0}\left\{\hat{\xi}_2\sigma_\theta^2\left(1-\frac{\sigma_\theta^2+\frac{1}{n_1+n_2}}{2(\sigma_\theta^2+\hat{\sigma}_\eta^2)}\right)-\frac{1}{2}n_1^2-cn_2\right\}. \tag{3.4}$$

Proposition 2. *Let $c^* \in (0,\infty)$ be a cutoff for the cost of obtaining information from the manager. If $c \geq c^*$ then the speculator obtains no information from the manager, $n_2 = 0$, and obtains*

$$n_1 = n^* \equiv \frac{-1+\sqrt{1+4\sigma_\theta^2\left(\frac{\sigma_y\sigma_\theta^2}{2}\right)^{\frac{2}{3}}}}{2\sigma_\theta^2}$$

pieces of information from their own research. If $c \in (0, c^*)$, then the speculator chooses $n_1 = c$

and $n_2 = n - c$, where n solves the following equation:

$$\left(\frac{\sigma_y \sigma_\theta^2}{2c}\right)^{\frac{2}{3}} = \sigma_\theta^2 n^{\frac{4}{3}} + n^{\frac{1}{3}}. \tag{3.5}$$

The cutoff is given by $c^* = n^*$ and the speculator information choice n_1, n_2 is continuous in c on $\mathbb{R}_{++}$. If $c = 0$, then the speculator chooses $n_1 = 0$ and $n_2 = n \nearrow \infty$.

Proof. See Appendix A.1. □

Proposition 2 shows that $n \equiv n_1 + n_2$ is given by n^* when $c \geq n^*$ and is a function of c otherwise. Specifically, a decrease in c increases overall information n but changes the source of information away from the speculator's own research—n_2 increases while n_1 decreases. When it becomes cheaper to obtain information from the manager, then the speculator relies more on it but relies less on information from their own research and is overall better informed about the firm's future prospects.

4 Optimal contract

The inside owner's payoff is given by expected firm value less the expected compensation paid to the manager. With compensation contracts that induce manager separation, expressions (2.2) and (2.4) can be used to write the inside owner's objective function as

$$\begin{aligned} E\Pi(\gamma) = {} & \rho \left\{ [1 - a_1(\gamma_L) - a_2(\gamma_L)]\, e(\gamma_L) - a_3(\gamma_L) \right\} \\ & + (1-\rho) \left\{ [1 - a_1(\gamma_H) - a_2(\gamma_H)]\, e(\gamma_H) - a_3(\gamma_H) \right\}, \end{aligned} \tag{4.1}$$

where $\Pi(\gamma) = [1 - a_1(\gamma) - a_2(\gamma)]\, e(\gamma) - a_3(\gamma)$ denotes the firm's profit when it is run by a manager with manipulation propensity γ.

Below, the dependence of the contract (a_1, a_2, a_3), manipulation choice m, and effort level e on manipulation propensity γ will be suppressed wherever possible to make notation less cumbersome. The inside owner understands that, since e and m are unobserved, manager effort must coincide with the manager's individually rational choice given the chosen contract (a_1, a_2, a_3).

Lemma 1. *For a given manipulation propensity γ and contract (a_1, a_2, a_3), the manager chooses effort and manipulation levels*

$$\begin{aligned} e &= \left(a_1 + \frac{\psi}{2} a_2\right), \\ m &= \frac{\psi}{2} \tilde{n} a_2 \gamma, \end{aligned}$$

where $\tilde{n} = {}^{n_2}/_{n}$.

Before I analyze the optimal linear contract when managers privately observe their respective manipulation propensity γ, the following section presents, for comparison, the case in which firm owners can observe γ as well.

4.1 Optimal compensation contract when γ is publicly observable

For the purpose of this section, suppose that the firm owner can observe manager manipulation propensity γ. Manager effort and manipulation are still unobserved. For a given γ, a firm chooses short-term and long-term equity incentives to maximize its profit,

$$\Pi(\gamma) = \max_{a_1, a_2} e - \frac{r}{2} Var(w) - q(e, m),$$

subject to effort and manipulation given by Lemma 1.

Proposition 3. *For given c and γ, the optimal linear compensation contract when γ is observable by the firm is characterized by equity incentives*

$$a_1 = \frac{1}{r\sigma_\varepsilon^2 + \left(1 + \frac{\psi}{2}F\right)(1 + r\sigma_\theta^2)} \quad \text{and} \quad a_2 = Fa_1,$$

with

$$F = \frac{r\sigma_\varepsilon^2}{\tilde{n}^2 \frac{\psi}{2}\gamma + r\sigma_\theta^2 \left(1 - \frac{\psi}{2}\right)}.$$

Proof. See Appendix A.1. □

4.2 Optimal compensation contract when γ is privately observed

A major concern in the model, when manipulation propensity γ is privately observed by managers, is that managers may use their private information to mislead market participants in a way that increases the expected value of short-term stock-price related pay. To see this formally, note that we can use Lemma 1 in equation (2.1) to write the utility of a manager with true manipulation propensity γ and announced manipulation propensity $\hat{\gamma}$ as

$$\begin{aligned} u(\gamma, \hat{\gamma}) \equiv & \left(\hat{a}_1 + \frac{\psi}{2}\hat{a}_2\right)(\hat{a}_1 + \hat{a}_2) + \left(\frac{\psi}{2}\tilde{n}\hat{a}_2\right)^2 (\gamma - \hat{\gamma}) + \hat{a}_3 \\ & - \frac{1}{2}\left(\hat{a}_1 + \frac{\psi}{2}\hat{a}_2\right)^2 - \frac{1}{2}\left(\frac{\psi}{2}\tilde{n}\hat{a}_2\right)^2 \gamma - \frac{r}{2}\left[\hat{a}_1^2(\sigma_\theta^2 + \sigma_\epsilon^2) + \psi\sigma_\theta^2 \hat{a}_2 \left(\hat{a}_1 + \frac{1}{2}\hat{a}_2\right)\right], \end{aligned} \tag{4.2}$$

where $(\hat{a}_1, \hat{a}_2, \hat{a}_3)$ denotes the contract that the firm offers when the firm and market participants expect the manager's manipulation propensity to be $\hat{\gamma}$. Parameters ψ and $\tilde{n}$ depend on firm owner choice for c when manipulation propensity is expected to be $\hat{\gamma}$. The second term is positive if the manager understates their propensity to manipulate the market participants' signal and surprises market participants with a stronger-than-expected signal s, thereby increasing the worth of the manager's short-term pay. Because the optimal linear contract is separating, this term is always zero—managers announce $\hat{\gamma} = \gamma$ by their choice of contract—and market participants fully anticipate manager manipulation of the signal.[12]

Maximization of expected firm profit, given by equation (4.1), subject to incentive compatibility and participation conditions yields the optimal linear compensation scheme. Manager incentive compatibility conditions are given by

$$u(\gamma_H, \gamma_H) \geq u(\gamma_H, \gamma_L), \quad u(\gamma_L, \gamma_L) \geq u(\gamma_L, \gamma_H), \tag{4.3}$$

and manager participation conditions are given by $u(\gamma, \gamma) \geq 0$ for $\gamma \in \{\gamma_L, \gamma_H\}$. Lemma 2 shows which of these conditions will be binding under an optimal linear compensation scheme.

[12]In equilibrium there is no uncertainty about manager reporting objectives, consistent with estimation results in Bertomeu, Cheynel, Li, and Liang (2020), who find little such uncertainty.

Lemma 2. *The optimal linear compensation scheme offers two contracts, indexed by $\gamma \in \{\gamma_L, \gamma_H\}$, such that*

1. *the speculator cost of obtaining information from the manager is c_L in the case of the contract indexed by γ_L and it is c_H otherwise,*

2. *managers with low manipulation propensity choose the contract indexed by γ_L and managers with high manipulation propensity choose the contract indexed by γ_H,*

3. *$u(\gamma_H, \gamma_H) = u(\gamma_H, \gamma_L)$; i.e., the incentive compatibility condition of managers with high manipulation propensity binds,*

4. *$u(\gamma_L, \gamma_L) \geq u(\gamma_L, \gamma_H)$ if and only if $\psi(\gamma_H)/2\tilde{n}(\gamma_H)a_2(\gamma_H) \geq \psi(\gamma_L)/2\tilde{n}(\gamma_L)a_2(\gamma_L)$; i.e., managers with high manipulation propensity receive stronger incentives to manipulate the short-term stock price,*

5. *$u(\gamma_H, \gamma_H) > u(\gamma_L, \gamma_L) = 0$; i.e., managers with low manipulation propensity receive their outside option of zero, while managers with high manipulation propensity receive an information rent.*

Using Lemma 2, the information rent enjoyed by managers with high manipulation propensity is obtained as follows:

$$\begin{aligned} u(\gamma_H, \gamma_H) = u(\gamma_H, \gamma_L) &= u(\gamma_L, \gamma_L) + \frac{1}{2}\left(\frac{\psi(\gamma_L)}{2}\tilde{n}(\gamma_L)\right)^2 a_2(\gamma_L)^2(\gamma_H - \gamma_L) \qquad (4.4) \\ &= \frac{1}{2}\left(\frac{\psi(\gamma_L)}{2}\tilde{n}(\gamma_L)\right)^2 a_2(\gamma_L)^2(\gamma_H - \gamma_L). \end{aligned}$$

Note that the information rent only depends on the contract chosen by managers with low manipulation propensity and on outside investor access to such managers.

Specifically, it only depends on short-term equity incentive pay of managers with low manipulation propensity and on their ability—determined by firm owners—to inform speculators about future firm performance.

Proposition 4. *Consider the following equity incentives:*

$$a_1(\gamma) = \frac{1}{r\sigma_\varepsilon^2 + \left(1 + \frac{\psi(\gamma)}{2}F(\gamma)\right)(1 + r\sigma_\theta^2)} \quad \text{and} \quad a_2(\gamma) = F(\gamma)a_1(\gamma),$$

with

$$F(\gamma_L) = \frac{r\sigma_\varepsilon^2}{\tilde{n}(\gamma_L)^2 \frac{\psi(\gamma_L)}{2}\bar{\gamma} + r\sigma_\theta^2\left(1 - \frac{\psi(\gamma_L)}{2}\right)}, \quad \bar{\gamma} = \gamma_L + \frac{1-\rho}{\rho}(\gamma_H - \gamma_L),$$
$$F(\gamma_H) = \frac{r\sigma_\varepsilon^2}{\tilde{n}(\gamma_H)^2 \frac{\psi(\gamma_H)}{2}\gamma_H + r\sigma_\theta^2\left(1 - \frac{\psi(\gamma_H)}{2}\right)}.$$

If the condition $\psi(\gamma_H)/2\tilde{n}(\gamma_H)a_2(\gamma_H) \geq \psi(\gamma_L)/2\tilde{n}(\gamma_L)a_2(\gamma_L)$ *is satisfied for given* $c(\gamma_L), c(\gamma_H)$ *then these equity incentives characterize an optimal compensation scheme conditional on outside investor access costs* $c(\gamma_L)$ *and* $c(\gamma_H)$*. Further, the condition is satisfied for access costs that maximize firm profit such that, in particular, the above equity incentives characterize an optimal compensation scheme when access costs are chosen optimally.*

Proof. See Appendix A.1. □

The proposition shows that the contract chosen by managers with high propensity to manipulate the short-term stock price puts more emphasis on the short-term stock price. When investors can obtain information from the manager at no cost, then all independent information production is crowded out. This corner solution corresponds to the special case analyzed in Schroth (2018). Specifically, when $c(\gamma_L) = c(\gamma_H) = 0$

then $\psi(\gamma_L) = \psi(\gamma_H)$ and the optimal contract characterized in Proposition 4 above is the same as the one in Proposition 4 in Schroth (2018).

5 Optimal outside investor access to the manager

Firm owners offer managers compensation contracts that link investor access to equity incentives in a way that increases firm profits. Access cost $c(\gamma)$ can depend on the manager type γ just as equity incentives $a_1(\gamma), a_2(\gamma)$ can. Lemma 3 shows that for given optimal equity incentives and information rents, the firm owner chooses access costs that maximize the efforts of every manager.[13]

Lemma 3. *Suppose the compensation scheme is optimal. When γ is observed by the firm owner, then firm profit is proportional to induced managerial effort, $\Pi(\gamma) = 1/2 e(\gamma)$. When γ is privately observed by the manager, then expected firm profit is proportional to expected managerial effort, $\mathrm{E}\Pi(\gamma) = 1/2 \left[\rho e(\gamma_L) + (1-\rho) e(\gamma_H)\right]$.*

When access cost is very high, when c is close to c^*, then allowing managers to communicate more with speculators has a first-order effect on stock-price informativeness ψ and a second-order effect on resources wasted on manipulation. The reason is that $n^* < \infty$—such that reducing c below c^* decreases σ_η^2 significantly—while the marginal cost of manipulation is zero at $c = c^*$. This intuition is formalized in proposition 5, which shows that $c(\gamma) < c^*$ for any $\gamma < \infty$.

[13] Effort $e(\cdot)$ depends on whether γ is privately observed such that $e^{private}(\gamma_H) = e^{public}(\gamma_H)$ but $e^{private}(\gamma_L) = e^{public}(\bar{\gamma}) < e^{public}(\gamma_L)$ (Proposition 4). (I suppress such superscripts throughout the paper to save notation.) When γ is privately observed by managers, then the optimal contract induces γ_L managers to provide the level of effort that a $\bar{\gamma}$ manager would provide if γ were observable by firm owners. The firm owner acts as if optimizing pointwise after adjusting γ_L upwards to account for the effect of the contract given to γ_L managers on the information rent enjoyed by γ_H managers. The adjusted manipulation propensity of γ_L managers is $\bar{\gamma} > \gamma_L$.

Proposition 5. *Under the optimal compensation scheme, the manager is allowed to talk to speculators: i.e., access costs are always less than c^*.*

Proof. See Appendix A.1. $\square$

Whether a stronger manager manipulation intent γ is associated with a higher cost of accessing the manager c depends on whether firm owners can observe γ. When firm owners can directly observe γ, then they choose $c(\gamma)$ to be an increasing function and thus constrain manager communication more when manipulation intent is stronger. However, when firm owners must pay information rents to learn γ, then they instead choose $c(\gamma)$ to be a decreasing function to reduce the information rent paid to γ_H-managers.

Proposition 6. *Under the optimal compensation scheme, when γ is publicly observable, then c is increasing in γ, and when γ is privately observed by managers, then c is decreasing in γ.*

Proof. See Appendix A.1. $\square$

Manager manipulation intent may be more difficult to observe in practice than equity incentives and outside investor access to management. However, Proposition 6 can be used together with Proposition 3 and Proposition 4 to show that the implied relationship between short-term focus of equity incentives and corporate governance is independent of whether manager manipulation intent is directly observable by firm owners.

When γ is publicly observable, then as γ increases equity incentive duration is increasing and access is limited. On the other hand, when γ is privately observed by managers, then as γ increases equity incentive duration is decreasing and access is expanded. In either case, the model unambiguously predicts that market participants should be given more access to managers who receive shorter equity incentive duration. There is a complementarity between short-term focus of equity incentives and investor access to management.

Proposition 7. *The optimal compensation scheme implies a positive relationship between the short-term focus of equity incentives and access to management. When managers privately observe manipulation intents, then, under an optimal compensation scheme, there is more manipulation at firms where access to managers is greater and where overall equity incentives are stronger.*

When firm owners make access to the manager conditional on manager manipulation propensity γ, then overall investor information and thus stock-price informativeness depend on γ. The short-term focus of equity incentives is then given by $\psi(\gamma)F(\gamma)$, rather than just $F(\gamma)$, because managers' pay depends not only on pay duration F but also on ψ, which is the informativeness of the interim stock price P regarding the liquidation value of the firm π. The overall equity incentive, or effort $e = a_1 + \psi/2 a_2 = (1 + \psi/2F)a_1$, is related positively to manipulation.

Studies of cross-sectional differences in managerial pay duration should directly take into account stock-price informativeness. While Gopalan, Milbourn, Song, and Thakor (2014) find a negative relationship between manipulation and the duration of equity pay, the model in this paper predicts such a negative relationship only in the special case where investors do not generate any independent information about firm value (as in Schroth, 2018). When investors generate some independent information, such that more access to management crowds out independent information, then the model predicts a negative relationship between manipulation and the duration of equity *incentives* ψF. The relationship between manipulation and the duration of equity pay F may be positive.

The notion of manipulation in this paper is linked to the provision of information to investors that crowds out independent investor research. This notion differs from the one in Bergstresser and Philippon (2006) and Gopalan, Milbourn, Song, and Thakor (2014), who focus on discretionary accruals. Their notion of manipulation is unlikely to be linked to any provision of information to investors that crowds out independent research about the long-term value of the firm. For example, managerial guidance, rather than discretionary accruals, may crowd out analyst forecasts.

Schroth (2018) offers an explanation for the relationships between equity incentive pay and earnings manipulation (positive abnormal accruals) documented in Bergstresser and Philippon (2006) and Gopalan et al. (2014). This paper, in contrast, focuses on managerial guidance that allows investors to better forecast future earnings. The implicit assumption in this paper is that earnings guidance—and especially more disaggregated or long-term projections—influences investor expectations about future firm performance significantly more than earnings manipulation. Specifically, the former is seen as crowding out independent investor research but the latter is not. Both the model in this paper and the one in Schroth (2018) have one period—earnings manipulation can be thought of as occurring in a sub-period close to the realization of the interim stock prices while managerial guidance occurs in an earlier sub-period.

Firms in practice differ greatly in the amount of guidance that managers provide to market participants. In the model, when managers differ in their manipulation propensity γ, then stock-price informativeness measured by n varies less than guidance measured by $\tilde{n}$ across firms. The reason is that an increase (decrease) in guidance not only increases stock-price informativeness but also crowds out (in) market participants' independent research about the value of the firm.

Lemma 4. *If manager manipulation propensities are private (public), then a higher γ is associated with more (less) guidance and crowding out (in) of independent research about firm value and, specifically, the relation*

$$\frac{d\tilde{n}}{dn} = (1 - \tilde{n})\frac{3}{2}\frac{3n\sigma_\theta^2 + 1}{n^2\sigma_\theta^2 + n}$$

is decreasing (increasing) in γ as long as finite guidance is optimal.

Proof. See Appendix A.1. □

5.1 Comparative statics

It may be optimal to not impose any constraints on communication between the manager and market participants. Lemma 5 provides sufficient conditions for when it is optimal to constrain manager communication with investors. It further reveals that high n^* can be a good enough reason to constrain manager communication. Indeed, when σ_θ^2 is high or σ_y is high, then the speculator already acquires a lot of information through their own research.[14] Partially crowding out the speculator's own research with biased communication from the manager is then less useful, especially if the manager's risk aversion is low anyway or if the manager's manipulation intent is high.

Lemma 5. *The optimal compensation scheme features some constraints on manager communication, $c > 0$, if $2r < n^*\gamma$ in the case in which γ is observable by the firm owner. When γ is privately observed by managers, then $c(\gamma_L) > 0$ if $2r < n^*\bar{\gamma}$ and $c(\gamma_H) > 0$ if $2r < n^*\gamma_H$.*

[14] An increase in σ_θ^2 when it is already very high, $\sigma_\theta^2(\sigma_y/2)^{2/5} > 6^{3/5}$, actually reduces n^* because the speculator is less willing to purchase information if the signal-to-noise ratio is close to one already.

Proof. See Appendix A.1. □

6 Endogenous market liquidity

So far, the expected trading volume of liquidity traders, σ_y, has been taken as given and it was assumed that the firm owners enjoy market liquidity at no cost. When firm inside owners internalize the cost of market liquidity σ_y, and can choose σ_y, then they choose σ_y, together with access cost c, to trade off the benefits of market monitoring not only against the cost of manipulation but also against the cost of market liquidity. The cost of market liquidity is given by the revenue that the speculator obtains by trading against liquidity traders.[15] Specifically, it is the discount that needs to be given to liquidity traders to compensate them for being exposed to liquidity shocks that require them to trade exogenous amounts $y \sim N(0, \sigma_y^2)$ of the firm stock with the informed speculator at the interim stage. Speculator revenue is the first term in equation (3.4), which can be simplified as follows:

$$R \equiv \frac{\sigma_\theta^2}{\left(\sigma_\theta^2 + \frac{1}{n}\right)^{1/2}} \frac{\sigma_y}{2}. \tag{6.1}$$

Proposition 2 shows that when firm owners choose both c and σ_y, then they effectively control both n and $\tilde{n}$. Specifically, if $n \in (0, \infty)$, then n is determined by σ_y/c and $\tilde{n} = (n-c)/n$. Firm owners can, for example, lower the cost of market liquidity R, while keeping constant the strength of market monitoring as measured by n by reduc-

[15] The cost of market liquidity determines the firm inside owner's choice of outside equity ownership. Bertomeu, Beyer, and Dye (2011) study the trade-off between (outside) equity and debt and refer to the speculator trading revenue as the firm's cost of capital. Easley and O'hara (2004) analyze in detail how firm owners can affect the cost of capital through their choice of accounting discretion and market microstructure.

ing both c and σ_y in the same proportion. When firm owners internalize the cost of market liquidity, then their incentive to increase outside investor access to managers is increased.

When the firm owner chooses a prohibitively high access cost $c \geq c^*$ and liquidity $\sigma_y \geq 0$, then Proposition 2 can be used use write speculator revenue as follows:

$$R^* = \frac{\sigma_\theta^2}{\left(\sigma_\theta^2 + \frac{1}{n^*}\right)^{1/2}} \frac{\sigma_y}{2} = n^{*2}(n^*\sigma_\theta^2 + 1).$$

In the case where the firm owner chooses access cost $c \in (0, c^*)$ and liquidity $\sigma_y > 0$, Proposition 2 can be used use write speculator revenue as follows:

$$R = n^2(n\sigma_\theta^2 + 1)(1 - \tilde{n}).$$

A more informative stock price comes at the cost of higher liquidity cost, while providing guidance is a way to keep the liquidity cost in check. R is increasing in n and decreasing in $\tilde{n}$. Finally, if the firm owner chooses free access, $c = 0$, then by Proposition 2 the firm owner can set $\sigma_y = 0$ such that $R = 0$ but n is unbounded. This benefit of greater access, to lower the cost of liquidity, is reflected in Proposition 8 below, while Proposition 9 shows that high manipulation intent is a reason to not set $c = 0$.

Proposition 8. *Under the optimal compensation scheme the manager is allowed to talk to speculators when firm owners internalize the cost of market liquidity. I.e., access costs are always less than $c^*(\sigma_y)$ when both c and σ_y are optimally chosen.*

Proof. See Appendix A.1. □

Proposition 9. *The optimal compensation scheme features some constraints on manager communication, $c > 0$, when manager manipulation propensity is sufficiently large.*

Proof. See Appendix A.1. □

6.1 Optimal liquidity choice when γ is publicly observed

Proposition 10. *Under the optimal compensation scheme, when γ is publicly observable then guidance $\tilde{n}$ and stock-price informativeness n are both decreasing in γ. Further, the short-term focus of equity incentives $\frac{\psi}{2}F$ is decreasing in γ, and long-term pay a_1 and cost of capital (liquidity) R are increasing in γ.*

Proof. See Appendix A.1. □

The proposition shows that guidance is a substitute for long-term pay and is positively related to the strength of short-term incentives as well as stock-price informativeness. Figure 1 shows that guidance is crowding out independent research, in the sense of $\tilde{n}$ responding more than n to changes in γ, even when the firm owner can choose both $\tilde{n}$ and n directly. In fact, the firm owner prefers to crowd in even more independent research by market participants when the manager has a higher propensity to manipulate. Stock liquidity σ_y is increasing in γ. As shown in Figure 2, the liquidity cost increases because the firm owner is willing to spend more on market monitoring when the manager is more inclined to manipulate. The liquidity cost, or cost of capital, R, is negatively related to guidance, manipulation, firm value, and stock-price informativeness.

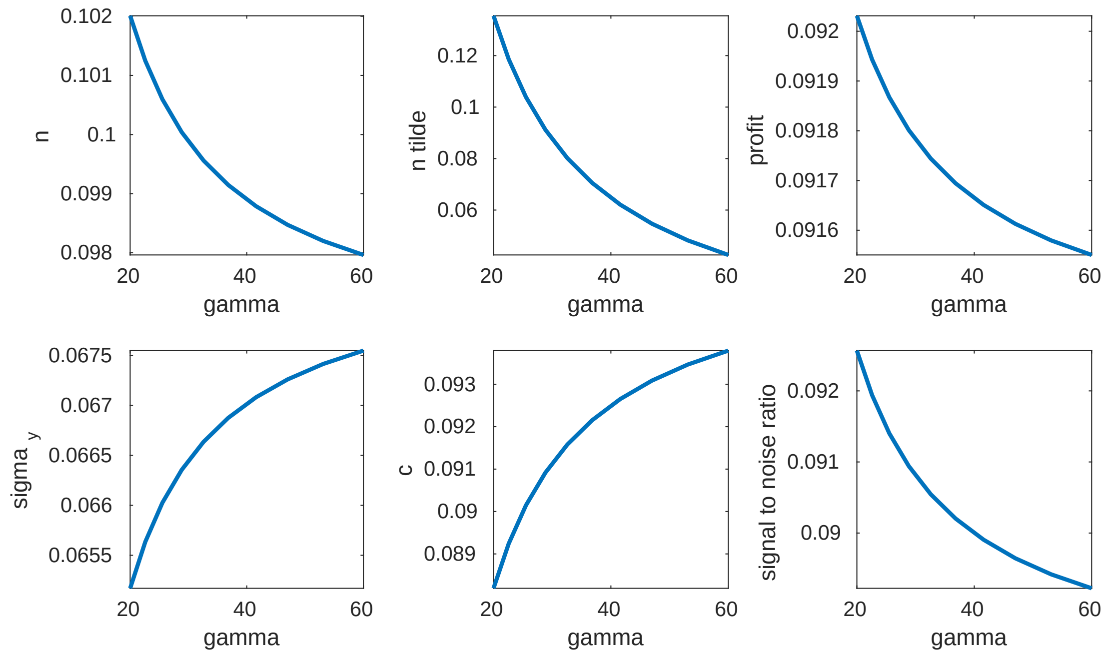

Figure 1: Numerical example for case of endogenous liquidity and public γ with parameter values $r = 0.5$, $\sigma_\theta^2 = 1$ and $\sigma_\varepsilon^2 = 10$.

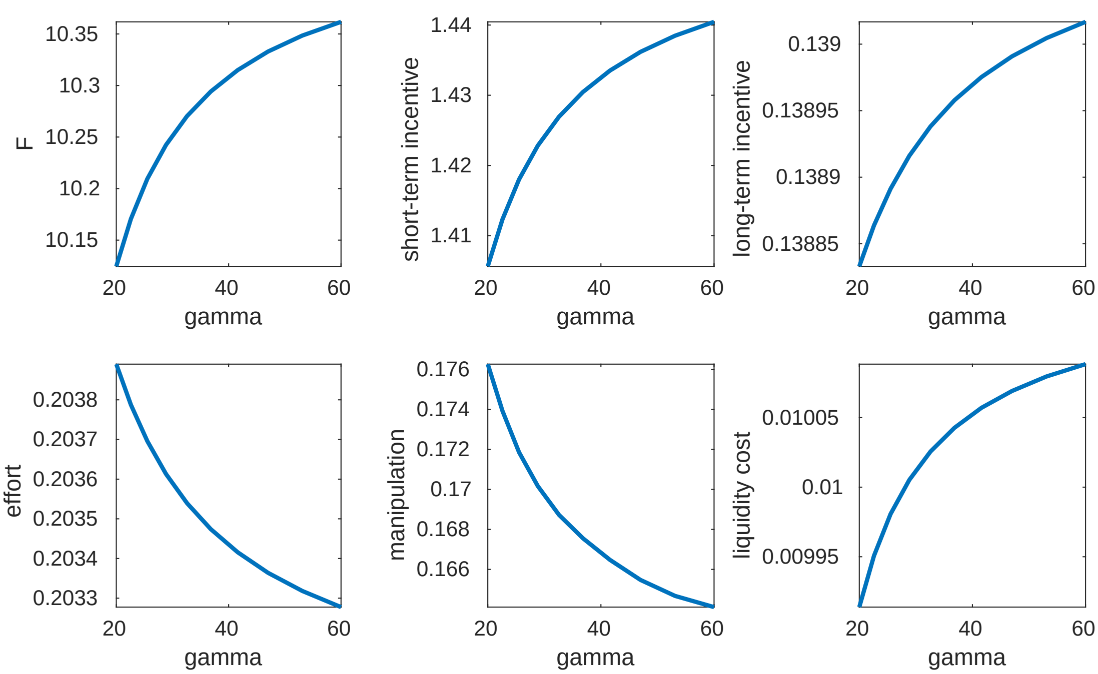

Figure 2: Numerical example for case of endogenous liquidity and public γ. The second and third panel show a_2 and a_1, respectively.

6.2 Optimal liquidity choice when γ is privately observed

Proposition 11. *Under the optimal compensation scheme, when γ is privately observed by the manager then guidance $\tilde{n}$ and stock-price informativeness n are both increasing in γ. Further, the short-term focus of equity incentives $\frac{\psi}{2}F$ and manipulation m are both increasing in γ, and long-term pay a_1 and cost of capital (liquidity) R are decreasing in γ.*

Proof. See Appendix A.1. □

The proposition shows that guidance is a substitute for long-term pay and is positively related to the strength of short-term incentives as well as stock-price informativeness. Figure 3 shows that guidance is crowding out independent research, in the sense of $\tilde{n}$ responding more than n to changes in γ, even when the firm owner can choose both $\tilde{n}$ and n directly. However, the firm owner prefers to crowd out even more independent research by market participants when the manager has a higher propensity to manipulate. Stock liquidity σ_y is decreasing in γ. As shown in Figure 4, the liquidity cost decreases as the firm owner relies less on market monitoring when the manager is more inclined to manipulate. The liquidity cost, or cost of capital, R is negatively related to guidance, manipulation, and stock-price informativeness. Proposition 12 summarizes the empirical predictions when firm owners choose both guidance and stock liquidity.

Proposition 12. *Under the optimal compensation scheme, when γ is privately observed by the manager then guidance $\tilde{n}$ is positively related to stock-price informativeness ψ, short-term equity incentives ψF, managerial effort e and manipulation m, and it is negatively related to long-term equity incentives a_1 and the cost of capital (or liquidity) R.*

The prediction that guidance and liquidity cost are negatively related is the same

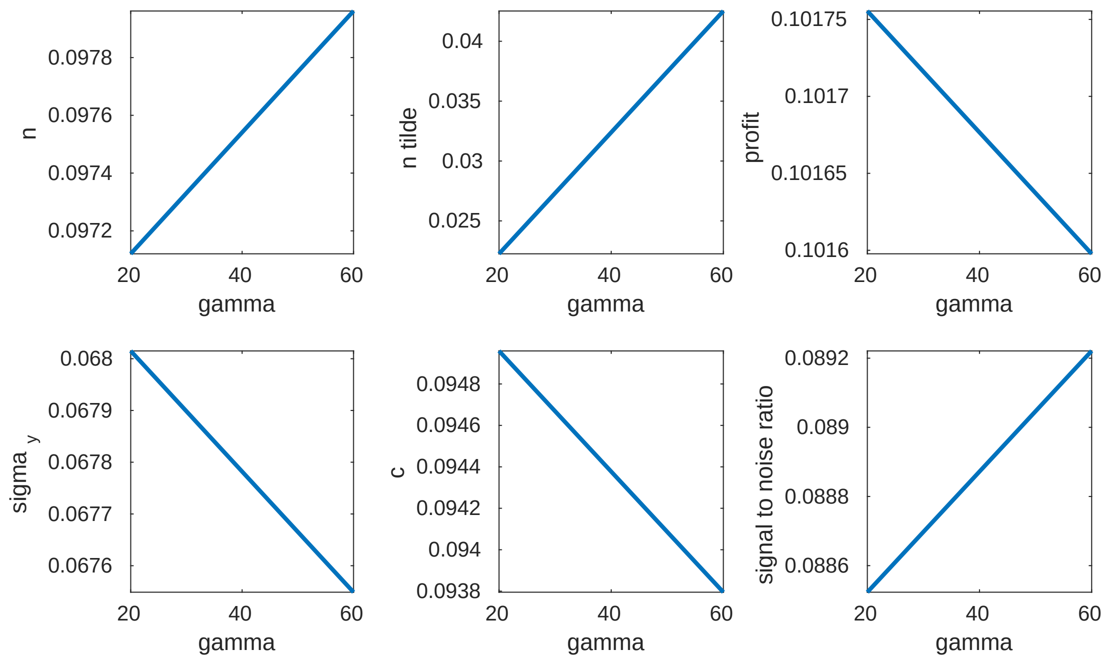

Figure 3: Numerical example for case of endogenous liquidity and private γ with parameter values $\gamma_L = 20$, $\gamma_H = 60$, $\rho = 0.3$, $r = 0.5$, $\sigma_\theta^2 = 1$ and $\sigma_\varepsilon^2 = 10$.

as in Bertomeu, Beyer, and Dye (2011) where voluntary disclosure reduces the cost of capital. A novel empirical prediction is that stock-price manipulation is positively related to guidance but negatively to liquidity cost. The cost of capital is lower at firms where managers manipulate the value of their short-term equity pay more.

The analysis in this paper gives an example for when the cost of capital is not necessarily a measure of the strength of accounting frictions. Despite the accompanying increase in voluntary disclosure, a decrease in cost of capital does not reflect a reduction in accounting frictions—on the contrary, it may reflect that the manager has greater intent to misstate the future value of the firm.

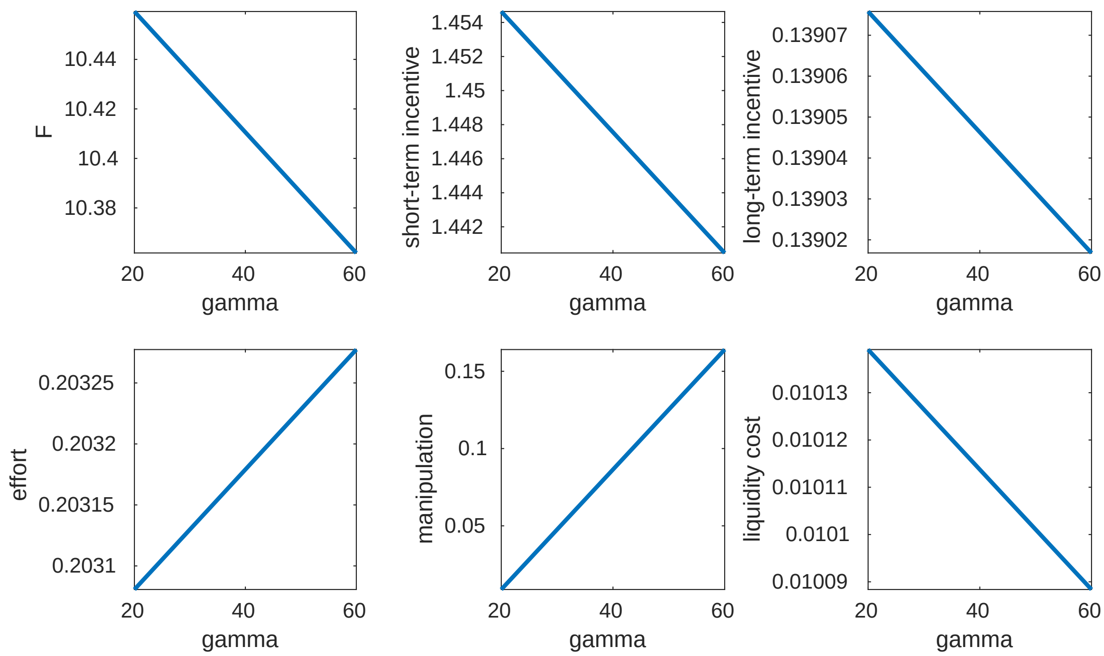

Figure 4: Numerical example for case of endogenous liquidity and private γ. The second and third panel show a_2 and a_1, respectively.

7 Conclusion

Outside investors value access to management because it helps them to form expectations about future prospects of the firm. But from the viewpoint of the inside firm owner, more is not necessarily better. The reason is that, because of short-term equity incentives, managers have a stronger incentive to attempt to manipulate information communicated to investors when investors rely on it more. While outside investors may be able to discount manager manipulation attempts, the inside firm owner has to ultimately bear the resource cost of any wasteful manager manipulation activity. This paper studies the trade-off that firm owners face between higher stock-price informativeness due to more manager communication with investors, and resources wasted due to manager manipulation.

I find that firm owners grant investors more access to management if managers are more risk averse or if liquidity of the firm stock is lower. Moreover, firm owners learn about manager reporting objectives by granting managers discretion in providing guidance about future prospects of the firm to outside investors. Managers more prone to manipulate voluntary disclosure exercise this discretion more. The main cross-sectional prediction is that firm owners grant investors more access to managers that manipulate more strongly.

This prediction also obtains in the case where firm owners can change the amount of shares held by outside investors (i.e., the liquidity of firm stocks) when contracting with managers. An additional prediction in that case is that access to managers reduces the cost of capital (i.e., the total discount given to unsophisticated liquidity traders). Taken together, these two predictions imply that, conditional on observable firm and manager characteristics, the cost of capital is *lower* at firms where managers bias guidance about future earnings more heavily. The cost of capital is thus lower at firms where managers exacerbate existing accounting frictions more. In other words, voluntary disclosure in the form of guidance about future earnings reduces firms' cost of capital, as concluded in much of the literature; however, the reason is not a reduction in accounting frictions but rather the opposite.

References

Aboody, D. and R. Kasznik (2000). CEO stock option awards and the timing of corporate voluntary disclosures. *Journal of Accounting and Economics 29*(1), 73–100.

Almazan, A., S. Banerji, and A. De Motta (2008). Attracting attention: Cheap managerial talk and costly market monitoring. *The Journal of Finance 63*(3), 1399–1436.

Anantharaman, D. and Y. Zhang (2011). Cover me: Managers' responses to changes in analyst coverage in the post-regulation FD period. *The Accounting Review 86*(6), 1851–1885.

Balakrishnan, K., M. B. Billings, B. Kelly, and A. Ljungqvist (2014). Shaping liquidity: On the causal effects of voluntary disclosure. *The Journal of Finance 69*(5), 2237–2278.

Bénabou, R. and J. Tirole (2016). Bonus culture: Competitive pay, screening, and multitasking. *Journal of Political Economy 124*(2), 305–370.

Bergstresser, D. and T. Philippon (2006). CEO incentives and earnings management. *Journal of Financial Economics 80*(3), 511–529.

Bertomeu, J., A. Beyer, and R. A. Dye (2011). Capital structure, cost of capital, and voluntary disclosures. *The Accounting Review 86*(3), 857–886.

Bertomeu, J., E. Cheynel, E. X. Li, and Y. Liang (2020). How pervasive is earnings management? Evidence from a structural model. *Management Science*, forthcoming.

Bushee, B. J., M. J. Jung, and G. S. Miller (2011). Conference presentations and the disclosure milieu. *Journal of Accounting Research 49*(5), 1163–1192.

Cohen, D. A., A. Dey, and T. Z. Lys (2008). Real and accrual-based earnings management in the pre-and post-Sarbanes-Oxley periods. *The Accounting Review 83*(3), 757–787.

Demerjian, P. R., B. Lev, M. F. Lewis, and S. E. McVay (2012). Managerial ability and earnings quality. *The Accounting Review 88*(2), 463–498.

Dikolli, S. S., T. Keusch, W. J. Mayew, and T. D. Steffen (2020). CEO behavioral integrity, auditor responses, and firm outcomes. *The Accounting Review 95*(2), 61–88.

Easley, D. and M. O'hara (2004). Information and the cost of capital. *The Journal of Finance 59*(4), 1553–1583.

Edmans, A., M. S. Heinle, and C. Huang (2016). The real costs of financial efficiency when some information is soft. *Review of Finance 20*(6), 2151–2182.

Enache, L., L. Li, and E. Riedl (2018). The disclosure of good versus bad news: Evidence from the biotech industry. Available at SSRN 3290822.

Ferreira, D., M. A. Ferreira, and C. C. Raposo (2011). Board structure and price informativeness. *Journal of Financial Economics 99*(3), 523–545.

Fishman, M. J. and K. M. Hagerty (1989). Disclosure decisions by firms and the competition for price efficiency. *The Journal of Finance 44*(3), 633–646.

Francis, J., J. D. Hanna, and D. R. Philbrick (1997). Management communications with securities analysts. *Journal of Accounting and Economics 24*(3), 363–394.

Francis, J., A. Huang, S. Rajgopal, and A. Zang (2008). CEO reputation and earnings quality. *Contemporary Accounting Research 25*(1), 109–147.

Francis, J., D. Nanda, and P. Olsson (2008). Voluntary disclosure, earnings quality, and cost of capital. *Journal of Accounting Research 46*(1), 53–99.

Frankel, R., M. Johnson, and D. J. Skinner (1999). An empirical examination of conference calls as a voluntary disclosure medium. *Journal of Accounting Research 37*(1), 133–150.

Garriott, C. and R. Riordan (2019). Trading on long-term information. Available at SSRN 3419065.

Goldman, E. and S. L. Slezak (2006). An equilibrium model of incentive contracts in the presence of information manipulation. *Journal of Financial Economics 80*(3), 603–626.

Gopalan, R., T. Milbourn, F. Song, and A. V. Thakor (2014). Duration of executive compensation. *The Journal of Finance 69*(6), 2777–2817.

Graham, J. R., C. R. Harvey, and S. Rajgopal (2005). The economic implications of corporate financial reporting. *Journal of Accounting and Economics 40*(1-3), 3–73.

Green, T. C., R. Jame, S. Markov, and M. Subasi (2014). Access to management and the informativeness of analyst research. *Journal of Financial Economics 114*(2), 239–255.

Guay, W., D. Samuels, and D. Taylor (2016). Guiding through the fog: Financial statement complexity and voluntary disclosure. *Journal of Accounting and Economics 62*(2-3), 234–269.

Hermalin, B. and M. Weisbach (2012). Information disclosure and corporate governance. *The Journal of Finance 67*(1), 195–234.

Hirst, D. E., L. Koonce, and S. Venkataraman (2007). How disaggregation enhances the credibility of management earnings forecasts. *Journal of Accounting Research 45*(4), 811–837.

Hollander, S., M. Pronk, and E. Roelofsen (2010). Does silence speak? An empirical analysis of disclosure choices during conference calls. *Journal of Accounting Research 48*(3), 531–563.

Holmstrom, B. and J. Tirole (1993). Market liquidity and performance monitoring. *Journal of Political Economy 101*(4), 678–709.

Jayaraman, S. and T. T. Milbourn (2011). The role of stock liquidity in executive compensation. *The Accounting Review 87*(2), 537–563.

Lara, J. M. G., B. G. Osma, and F. Penalva (2016). Accounting conservatism and firm investment efficiency. *Journal of Accounting and Economics 61*(1), 221–238.

Lev, B. and P. Zarowin (1999). The boundaries of financial reporting and how to extend them. *Journal of Accounting Research 37*(2), 353–385.

Lin, T.-C., Q. Liu, and B. Sun (2019). Contractual managerial incentives with stock price feedback. *American Economic Review 109*(7), 2446–2468.

Mayew, W. J. and M. Venkatachalam (2012). The power of voice: Managerial affective states and future firm performance. *The Journal of Finance 67*(1), 1–43.

Peng, L. and A. Röell (2014). Managerial incentives and stock price manipulation. *The Journal of Finance 69*(2), 487–526.

Schroth, J. (2018). Managerial compensation and stock price manipulation. *Journal of Accounting Research 56*(5), 1335–1381.

Srivastava, A. (2014). Why have measures of earnings quality changed over time? *Journal of Accounting and Economics 57*(2-3), 196–217.

Stein, J. C. (1989). Efficient capital markets, inefficient firms: A model of myopic corporate behavior. *The Quarterly Journal of Economics 104*(4), 655–669.

Strobl, G. (2013). Earnings manipulation and the cost of capital. *Journal of Accounting Research 51*(2), 449–473.

Terry, S. J., T. M. Whited, and A. A. Zakolyukina (2018). Information distortion, R&D, and growth. In *2018 Meeting Papers*, Number 217. Society for Economic Dynamics.

Wall Street Journal (2018). Short-termism is harming the economy, June 6th.

A Appendix

A.1 Proofs

Proof of Proposition 1. The steps are the same as in Holmstrom and Tirole (1993), the only exception being that the mean of the signal is $\hat{e} + \frac{n_2}{n_1+n_2}\hat{m}$ rather than $\hat{e}$. However, the mean of the signal drops out of the expression for the price, and speculator demand is exactly as in Holmstrom and Tirole (1993).

The market maker observes demand $q = y + x(s)$ and expects speculator information choice $\hat{n}_1$ and $\hat{n}_2$. Define $\hat{\sigma}_\eta^2 = \frac{1}{\hat{n}_1+\hat{n}_2}$. The market maker expects speculator demand parameters to be $\hat{\xi}_1$ and $\hat{\xi}_2$. Given market-maker information, the firm stock price is

$$P = \mathrm{E}\left[\pi|q\right] = \mathrm{E}\left[\hat{e} + \theta + \varepsilon \,\middle|\, y + \hat{\xi}_1 + \hat{\xi}_2\left(\hat{e} + \frac{\hat{n}_2}{\hat{n}_1+\hat{n}_2}\hat{m} + \theta + \eta\right) = q\right],$$

where E denotes expectations over y, θ, ε and η. Because these random variables are independently normally distributed, the stock price can be written as follows:

$$P = \hat{e} + \left[q - \hat{\xi}_1 - \hat{\xi}_2 \left(\hat{e} + \frac{\hat{n}_2}{\hat{n}_1 + \hat{n}_2} \hat{m} \right) \right] \frac{\hat{\xi}_2 \sigma_\theta^2}{\sigma_y^2 + \hat{\xi}_2^2 (\sigma_\theta^2 + \hat{\sigma}_\eta^2)}.$$

The speculator knows what the market maker observes and understands how the market maker forms expectations. Given information choice n_1, n_2 and the signal s, the speculator chooses demand x to maximize trading profit:

$$x = \arg\max_{\tilde{x}} \left\{ \tilde{x} \left(\mathbb{E}(\pi|s) - \mathbb{E}(P|\tilde{x}) \right) \right\}.$$

The conditional expectation of the speculator can be substituted as follows:

$$\begin{aligned}
\mathbb{E}(\pi|s) &= \hat{e} + \left(s - \hat{e} - \frac{n_2}{n_1 + n_2} \hat{m} \right) \frac{\sigma_\theta^2}{\sigma_\theta^2 + \sigma_\eta^2}, \\
\mathbb{E}(P|\tilde{x}) &= \hat{e} + \left[\tilde{x} - \hat{\xi}_1 - \hat{\xi}_2 \left(\hat{e} + \frac{\hat{n}_2}{\hat{n}_1 + \hat{n}_2} \hat{m} \right) \right] \frac{\hat{\xi}_2 \sigma_\theta^2}{\sigma_y^2 + \hat{\xi}_2^2 (\sigma_\theta^2 + \hat{\sigma}_\eta^2)}.
\end{aligned}$$

The speculator trading rule is verified by taking the first-order condition with respect to $\tilde{x}$, evaluating $\hat{n}_1 = n_1$, $\hat{n}_2 = n_2$, $\hat{\sigma}_\eta^2 = \sigma_\eta^2$, $\hat{\xi}_1 = \xi_1$ and $\hat{\xi}_2 = \xi_2$ at equilibrium, solving for $x(s)$, and matching coefficients ξ_1 and ξ_2. The equilibrium stock price then follows immediately. □

Proof of Proposition 2. Taking first-order conditions of the speculator's objective (3.4) and allowing for the possibility that $n_2 \geq 0$ binds yield the two cases. Note that I assume that the speculator chooses an infinite amount of signals from the manager ($n_2 = \infty$) when they are free ($c = 0$) even when there is no strict need to obtain them (i.e., when $\sigma_y = 0$). In other words, the firm owner can choose to let c go to zero faster than σ_y with the result that σ_y/c can be unbounded. ☐

Proof of Proposition 3. For given γ, firm profit is given as follows:

$$\Pi = a_1 + \frac{\psi}{2}a_2 - \frac{1}{2}\left(a_1 + \frac{\psi}{2}a_2\right)^2 - \frac{1}{2}\left(\frac{\psi}{2}\tilde{n}a_2\right)^2\gamma - \frac{r}{2}\left[a_1^2(\sigma_\theta^2 + \sigma_\epsilon^2) + \psi\sigma_\theta^2 a_2\left(a_1 + \frac{1}{2}a_2\right)\right].$$

Maximization of Π with respect to a_1 and a_2 yields the optimal equity incentives. ☐

Proof of Proposition 4. Assuming the condition $\psi(\gamma_H)/2\tilde{n}(\gamma_H)a_2(\gamma_H) \geq \psi(\gamma_L)/2\tilde{n}(\gamma_L)a_2(\gamma_L)$ is satisfied, the above equity incentives maximize expected firm profit

$$\begin{aligned}
E\Pi(\gamma) = \rho\Bigg\{& a_1(\gamma_L) + \frac{\psi(\gamma_L)}{2}a_2(\gamma_L) - \frac{1}{2}\left(a_1 + \frac{\psi(\gamma_L)}{2}a_2(\gamma_L)\right)^2 - \frac{1}{2}\left(\frac{\psi(\gamma_L)}{2}\tilde{n}(\gamma_L)a_2(\gamma_L)\right)^2\gamma_L \\
&-\frac{r}{2}\left[a_1(\gamma_L)^2(\sigma_\theta^2 + \sigma_\epsilon^2) + \psi(\gamma_L)\sigma_\theta^2 a_2(\gamma_L)\left(a_1(\gamma_L) + \frac{1}{2}a_2(\gamma_L)\right)\right]\Bigg\} \\
+(1-\rho)\Bigg\{& a_1(\gamma_H) + \frac{\psi(\gamma_H)}{2}a_2(\gamma_H) - \frac{1}{2}\left(a_1 + \frac{\psi(\gamma_H)}{2}a_2(\gamma_H)\right)^2 - \frac{1}{2}\left(\frac{\psi(\gamma_H)}{2}\tilde{n}(\gamma_H)a_2(\gamma_H)\right)^2\gamma_H \\
&-\frac{1}{2}\left(\frac{\psi(\gamma_L)}{2}\tilde{n}(\gamma_L)\right)^2 a_2(\gamma_L)^2(\gamma_H - \gamma_L) \\
&-\frac{r}{2}\left[a_1(\gamma_H)^2(\sigma_\theta^2 + \sigma_\epsilon^2) + \psi(\gamma_H)\sigma_\theta^2 a_2(\gamma_H)\left(a_1(\gamma_H) + \frac{1}{2}a_2(\gamma_H)\right)\right]\Bigg\}.
\end{aligned}$$

Now suppose access costs are optimal; then by Proposition 6 it follows that $c(\gamma_L) \geq c(\gamma_H)$ and thus $\tilde{n}(\gamma_L) < \tilde{n}(\gamma_H)$ and $\psi(\gamma_L) < \psi(\gamma_H)$. The condition is then satisfied if $\psi(\gamma_H)/2a_2(\gamma_H) \geq \psi(\gamma_L)/2a_2(\gamma_L)$, which can be written as $\tilde{n}(\gamma_H)^2\gamma_H + 2r/n(\gamma_H) \leq \tilde{n}(\gamma_L)^2\bar{\gamma} + 2r/n(\gamma_L)$. By Lemma 3, access costs that maximize expected firm profit maximize effort point-wise such that

$$c(\gamma_L) = \arg\max_c \psi(\gamma_L)F(\gamma_L) = \arg\min_c \tilde{n}(c)^2\bar{\gamma} + {}^{2r}/_{n(c)},$$
$$c(\gamma_H) = \arg\max_c \psi(\gamma_H)F(\gamma_H) = \arg\min_c \tilde{n}(c)^2\gamma_H + {}^{2r}/_{n(c)}.$$

The condition then holds because $\tilde{n}(c)^2 \geq 0$ and $\bar{\gamma} > \gamma_H$ for $\rho < 1/2$. □

Proof of Proposition 5. Let $e(\gamma)$ denote effort when γ is observable. By proposition 4, effort depends on c only through $\psi(\gamma)/2F(\gamma)$. For $c < c^*$, proposition 2 gives the marginal effects $d\tilde{n}/dc$ and dn/dc. Then

$$\frac{d}{dc}\frac{\psi(\gamma)}{2}F(\gamma) = \frac{r\sigma_\varepsilon^2\left[2\tilde{n}\left(\frac{1}{n} - \frac{c}{n^2}\frac{dn}{dc}\right)\gamma + \frac{2r}{n^2}\frac{dn}{dc}\right]}{\left[\tilde{n}^2\gamma + r\left(\frac{2}{n} + \sigma_\theta^2\right)\right]^2},$$

which is negative for c close to c^* ($\tilde{n}$ close to zero) because $dn/dc < 0$. Therefore, $c < c^*$ is optimal for all γ.[16]

When γ is privately observed by the manager, then effort of a γ_H manager is undistorted at $e(\gamma_H)$. Effort of the γ_L type is distorted at $e(\bar{\gamma})$. Because $e(\gamma)$ is decreasing in c arbitrarily close to c^*, it follows that $\mathrm{E}\Pi(\gamma)$ is highest for some $c(\gamma_L), c(\gamma_H) < c^*$. □

Proof of Proposition 6. Suppose γ is publicly observed by managers and $c(\gamma) > 0$ (when $c(\gamma) = 0$ then $c(\gamma) \leq c(\gamma')$ for any $\gamma' > \gamma$). When $c(\gamma)$ is chosen optimally and $c(\gamma) > 0$, then $\frac{d}{dc}\psi(\gamma)/2F(\gamma) = 0$. For $\gamma' > \gamma$ it follows that $\frac{d}{dc}\,\psi(\gamma')/2F(\gamma')|_{c=c(\gamma)} > 0$. Suppose now γ is privately observed by managers and $c(\gamma_H) > 0$ (when $c(\gamma_H) = 0$ then $c(\gamma_H) \leq c(\gamma_L)$). $\mathrm{E}\Pi(\gamma)$ depends on $c(\gamma_H)$ only through $e(\gamma_H)$. When $c(\gamma_H)$ is

[16] $n \to \infty$ is a always local optimum, and it is a global one if γ is low enough. For each γ it is possible to find a N_γ such that $\frac{d}{dc}\psi(\gamma)/2F(\gamma) < 0$ for all c such that $n(c) \geq N_\gamma$; i.e., when access cost c is low enough then firm profit increases locally when c is decreased further.

chosen optimally and $c(\gamma_H) > 0$, then $\frac{d}{dc}\psi(\gamma_H)/2F(\gamma_H) = 0$. Because $\bar{\gamma} > \gamma_H$, it follows that $\frac{d}{dc}\ \psi(\gamma_L)/2F(\gamma_L)|_{c=c(\gamma_H)} > 0$. $\square$

Proof of Lemma 4. How guidance depends on γ is given by Proposition 6, while equation (3.5) links guidance to stock-price informativeness through the optimal speculator information acquisition choice. $\square$

Proof of Lemma 5. The sufficient condition is $e(\gamma)|_{c=0} < e(\gamma)|_{c=c^*}$. Note that this condition is strong because we know from Proposition 5 that $c = c^*$ is never optimal. $\square$

Proof of Proposition 8. Define the decreasing function

$$G(z) \equiv \frac{1/2}{\frac{r\sigma_\varepsilon^2}{1+\frac{r\sigma_\varepsilon^2}{z}} + 1 + r\sigma_\theta^2}$$

on $(0, \infty)$. G is bounded as follows:

$$\lim_{z\to\infty} G(z) = \frac{1/2}{1 + r(\sigma_\varepsilon^2 + \sigma_\theta^2)} < G(z) < \lim_{z\to 0} G(z) = \frac{1/2}{1 + r\sigma_\theta^2}.$$

When γ is publicly observed, then by Lemma 3 firm profit is

$$\Pi = G\left(\tilde{n}^2\gamma + r(\sigma_\theta^2 + 2/n)\right) - (1-\tilde{n})n^2(n\sigma_\theta^2 + 1)$$

and the first derivative with respect to manipulation effectiveness $\tilde{n}$ is

$$\frac{\partial \Pi}{\partial \tilde{n}} = G'\left(\tilde{n}^2\gamma + r(\sigma_\theta^2 + 2/n)\right) 2\tilde{n}\gamma + n^2(n\sigma_\theta^2 + 1)$$

with

$$G'(z) = -\left[\left(1 + r\sigma_\theta^2\right)\left(1 + \frac{z}{r\sigma_\varepsilon^2}\right) + z\right]^{-2} \in (-\infty, 0).$$

For $c \geq c^*(\sigma_y)$, the benefit of reducing the cost of market liquidity with access to management dominates, $\frac{\partial \Pi}{\partial \tilde{n}} \mid_{\tilde{n}=0} > 0$, such that no access is never optimal whenever there is market monitoring ($n > 0$).

When γ is privately observed, then by Lemma 3 firm profit is

$$\begin{aligned}\Pi =& \rho\left[G\left(\tilde{n}_L^2\bar{\gamma} + r(\sigma_\theta^2 + 2/n_L)\right) - (1 - \tilde{n}_L)n_L^2(n_L\sigma_\theta^2 + 1)\right] \\ &+ (1 - \rho)\left[G\left(\tilde{n}_H^2\gamma_H + r(\sigma_\theta^2 + 2/n_H)\right) - (1 - \tilde{n}_H)n_H^2(n_H\sigma_\theta^2 + 1)\right]\end{aligned}$$

with $\frac{\partial \Pi}{\partial \tilde{n}_L} \mid_{\tilde{n}_L=0} > 0$ and $\frac{\partial \Pi}{\partial \tilde{n}_H} \mid_{\tilde{n}_H=0} > 0$ such that no access is never optimal. □

Proof of Proposition 9. By Proposition 8, if $\Pi \mid_{\tilde{n}=0} > \Pi \mid_{\tilde{n}=1}$, then $c > 0$ (i.e., $\tilde{n} < 1$) is optimal. This is a strong condition. Firm profits in these two special cases is given by

$$\Pi \mid_{\tilde{n}=0} = G\left(r(\sigma_\theta^2 + 2/n^*(\sigma_y))\right) - n^{*2}(\sigma_y)(n^*(\sigma_y)\sigma_\theta^2 + 1)$$

and either $\Pi \mid_{\tilde{n}=1} = G\left(\gamma + r\sigma_\theta^2\right)$, if γ is publicly observed, or $\Pi \mid_{\tilde{n}=1} = \rho G\left(\bar{\gamma} + r\sigma_\theta^2\right) + (1 - \rho)G\left(\gamma_H + r\sigma_\theta^2\right)$ otherwise. The condition $\Pi \mid_{\tilde{n}=0} > \Pi \mid_{\tilde{n}=1}$ is not satisfied when $\sigma_y = 0$ because $\Pi \mid_{\tilde{n}=0, \sigma_y=0} = \lim_{z\to\infty} G(z) = \frac{1/2}{1+r(\sigma_\varepsilon^2+\sigma_\theta^2)} \leq \Pi \mid_{\tilde{n}=1}$ with equality only for $\gamma \to \infty$ (i.e., G is decreasing). However, because

$$\frac{\partial \Pi}{\partial n} \mid_{\tilde{n}=0} = 2r\left[\frac{2}{\sigma_\varepsilon^2}\left(1 + r(\sigma_\theta^2 + \sigma_\varepsilon^2)\right)\right]^{-2} > 0$$

as $n \to 0$ (or equivalently as $\sigma_y \to 0$), it follows that the condition holds for some

$\sigma_y > 0$ if γ large enough. $\square$

Proof of Proposition 10. Suppose the optimal choices are interior such that $\tilde{n} < 1$ and $n < \infty$. The first derivatives of firm profit are given as follows:

$$\frac{\partial \Pi}{\partial \tilde{n}} = 2\tilde{n}\gamma G'\left(\tilde{n}^2\gamma + r(\sigma_\theta^2 + {}^2/_n)\right) + n^2(n\sigma_\theta^2 + 1)$$
$$\frac{\partial \Pi}{\partial n} = -\frac{2r}{n^2}G'\left(\tilde{n}^2\gamma + r(\sigma_\theta^2 + {}^2/_n)\right) - (1-\tilde{n})(3n^2\sigma_\theta^2 + 2n).$$

Because $G'' > 0$ the expression $\partial\Pi/\partial n$ is decreasing in γ for given $\tilde{n}$ and n. Therefore, the optimal n is lower when γ is higher. When n is optimal then $\partial\Pi/\partial n = 0$ and the expression $\partial\Pi/\partial\tilde{n}$ can be written as follows:

$$\left.\frac{\partial \Pi}{\partial \tilde{n}}\right|_{\frac{\partial\Pi}{\partial n}=0} = -\gamma\tilde{n}(1-\tilde{n})\frac{3n^2\sigma_\theta^2 + 2n}{r} + constant,$$

where the constant term does not depend on γ directly. Therefore, at an optimum $\tilde{n}$, is decreasing in γ as well.

By revealed preference, effort is decreasing in γ because the compensation contract is then more distorted to counter manager manipulation incentives. Note that effort is given by $e = (1 + \psi/2F)a_1$, which is increasing in $\psi/2F$. Thus, $\psi/2F$ decreases in γ. Long-term pay a_1 is decreasing in $\psi/2F$ and thus increases in γ. By revealed preference, the cost of liquidity is increasing in γ because market monitoring becomes more expensive for the firm owner if the cost, in terms of resources wasted on manipulation, of substituting costly market liquidity with cheap guidance increases. $\square$

Proof of Proposition 11. The proof is the same as the one for Proposition 10 except that all effects are reversed because the firm owner takes into account the information rent payable to γ_H managers. Specifically, the firm owner treats γ_L managers as if they had manipulation propensity $\bar{\gamma} \geq \gamma_H$. Note that such an argument would not apply to managerial manipulation because it also directly depends on the manager manipulation propensity (and not just indirectly through the contract).

Revealed preference confirms the monotonicity requirement $\psi_H \tilde{n}_H a_{2,H} \geq \psi_L \tilde{n}_L a_{2,L}$. But then manipulation is also increasing in γ by Lemma 1. $\square$